

1 WHAT IS CLAIMED IS:

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3 1. A synchronizer for compulsorily synchronizing a plurality of  
4 video players for simultaneous display of as many correlated pictures, each  
5 video player being for use with a video storage medium on which there  
6 is stored a video signal including a series of vertical sync pulses, the  
7 synchronizer comprising:

8 (a) a plurality of vertical sync pulse separator circuits to be con-  
9 nected one to each video player for separating a series of  
10 vertical sync pulses from a video signal being recovered  
11 from a video storage medium;

12 (b) a reference moment determination circuit connected to the vertical  
13 sync pulse separator circuits for determination of a refer-  
14 ence moment in prescribed time relationship to each vertical  
15 sync pulse of one selected series of such pulses being  
16 supplied from either of the vertical sync pulse separator  
17 circuits; and

18 (c) a play synchronization circuit connected to the vertical sync pulse  
19 separator circuits and the reference moment determination  
20 circuit for production of a plurality of phase departure  
21 signals each indicative of a phase departure, if any, of  
22 each vertical sync pulse of one series of such pulses from  
23 the reference moment determined in relation to one associat-  
24 ed vertical sync pulse of the selected series of such  
25 pulses, the phase departure signals being for delivery one  
26 to each video player for causing the video players to pro-  
27 duce the series of vertical sync pulses in phase with each  
28 other.

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30 2. The video player synchronizer of claim 1 wherein the ref-  
31 erence moment determination circuit is adapted to determine the reference  
32 moments in prescribed time relationship to the series of vertical sync  
33 pulses that is most advanced in phase.

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35 3. The video player synchronizer of claim 1 wherein the ref-  
36 erence moment determination circuit is adapted to determine the reference

1 moments in prescribed time relationship to the series of vertical sync  
2 pulses that is most delayed in phase.

3  
4 4. The video player synchronizer of claim 1 wherein the video  
5 signal contains one vertical sync pulse per field, and wherein the refer-  
6 ence moment determination circuit is adapted to determine the reference  
7 moment at the trailing edge of each pulse of that series of vertical sync  
8 pulses which is most delayed in phase.

9  
10 5. The video player synchronizer of claim 1 wherein the play  
11 synchronization circuit comprises a plurality of *D* flip-flops each having a  
12 clock input connected to one vertical sync pulse separator circuit, a data  
13 input connected to a supply terminal, a reset input connected to the ref-  
14 erence moment determination circuit, and an output to be connected to  
15 one video player for delivery of one phase departure signal thereto.

16  
17 6. The video player synchronizer of claim 5 wherein the ref-  
18 erence moment determination circuit has inputs connected to the outputs  
19 of the flip-flops of the play synchronization circuit for determination of  
20 the reference moment in response to outputs therefrom.

21  
22 7. The video player synchronizer of claim 1 wherein each vid-  
23 eo player has drive means for creating relative scanning motion between  
24 the video storage medium and a transducer under the control of a servo  
25 signal, and wherein the synchronizer further comprises output means for  
26 delivery of one phase departure signal and one servo signal to each vid-  
27 eo player.

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29 8. The video player synchronizer of claim 1 further comprising  
30 a status judgment circuit whereby the synchronizer is permitted to syn-  
31 chronize the video players only when all the video players are in play  
32 mode.

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34 9. The video player synchronizer of claim 1 further comprising  
35 means for permitting the play synchronization circuit to produce the phase  
36 departure signals for delivery to only those video players which are in

1 play mode.

2

3 10. A synchronizer for compulsorily synchronizing a first and a  
4 second video player for simultaneous display of correlated pictures, each  
5 video player being for use with a video storage medium on which there  
6 is stored a video signal including a series of vertical sync pulses, the  
7 synchronizer comprising:

8 (a) a first vertical sync pulse separator circuit to be connected to a  
9 first video player for separating a first series of vertical  
10 sync pulses from a first video signal being recovered from  
11 a first video storage medium;

12 (b) a second vertical sync pulse separator circuit to be connected to  
13 a second video player for separating a second series of  
14 vertical sync pulses from a second video signal being re-  
15 covered from a second video storage medium;

16 (c) a reference moment determination circuit connected to the first  
17 and the second vertical sync pulse separator circuit for  
18 determination of a reference moment in prescribed time rela-  
19 tionship to each vertical sync pulse of a selected one of  
20 the first and the second series of such pulses being sup-  
21 plied from the first and the second vertical sync pulse  
22 separator circuit; and

23 (d) a play synchronization circuit comprising a first and a second *D*  
24 flip-flop having clock inputs connected respectively to the  
25 first and the second vertical sync pulse separator circuit,  
26 reset inputs connected to the reference moment determina-  
27 tion circuit, and data inputs connected to a supply terminal,  
28 for production of a first phase departure signal indicative  
29 of a phase departure, if any, of each vertical sync pulse  
30 of the first series from the reference moment determined in  
31 relation to one associated vertical sync pulse of the select-  
32 ed series, and a second phase departure signal indicative of  
33 a phase departure, if any, of each vertical sync pulse of  
34 the second series from the reference moment determined in  
35 relation to one associated vertical sync pulse of the select-  
36 ed series, the first and the second phase departure signal

1 being for delivery to the first and the second video play-  
2 er, respectively, for causing the same to synchronize the  
3 first and the second series of vertical sync pulses.  
4

5 11. The video player synchronizer of claim 10 wherein the ref-  
6 erence moment determination circuit comprises:

- 7 (a) an OR gate having inputs connected respectively to the first and  
8 the second vertical sync pulse separator circuit;  
9 (b) a NOR gate having inputs connected respectively to the first and  
10 the second flip-flop of the play synchronization circuit; and  
11 (c) a *D* flip-flop having a clock input connected to the OR gate, a  
12 data input connected to the NOR gate, and an output con-  
13 nected to the reset inputs of the first and the second  
14 flip-flop of the play synchronization circuit.  
15

16 12. The video player synchronizer of claim 10 wherein the first  
17 and the second video player have drive means for creating relative scan-  
18 ning motion between the video storage medium and a transducer under  
19 the control of a first and a second servo signal, respectively, and where-  
20 in the play synchronization circuit of the synchronizer further comprises:

- 21 (a) a first adder having one input connected to the output of the  
22 first flop-flop, another input to be connected to the second  
23 video player for inputting the second servo signal, and an  
24 output to be connected to the drive means of the second  
25 video player; and  
26 (b) a second adder having one input connected to the output of the  
27 second flip-flop, another input to be connected to the first  
28 video player for inputting the first servo signal, and an  
29 output to be connected to the drive means of the first  
30 video player.  
31

32 13. The video player synchronizer of claim 10 wherein the first  
33 and the second video player have drive means for creating relative scan-  
34 ning motion between the video storage medium and a transducer under  
35 the control of a first and a second servo signal, respectively, and where-  
36 in the play synchronization circuit of the synchronizer further comprises:

1 (a) a first subtracter having one input connected to the output of  
2 the first flop-flop, another input to be connected to the  
3 first video player for inputting the first servo signal, and  
4 an output to be connected to the drive means of the first  
5 video player; and

6 (b) a second subtracter having one input connected to the output of  
7 the second flip-flop, another input to be connected to the  
8 second video player for inputting the second servo signal,  
9 and an output to be connected to the drive means of the  
10 second video player.

11  
12 14. The video player synchronizer of claim 10 wherein the play  
13 synchronization circuit further comprises:

14 (a) a first logic circuit having inputs connected to the first and the  
15 second flip-flop for passing all output pulses thereof;

16 (b) a second logic circuit having inputs connected to the first flip-  
17 flop and the first logic circuit for producing a pulse when  
18 an inversion of the output from the first flip-flop is of  
19 the same binary state as the output from the first logic  
20 circuit; and

21 (c) a third logic circuit having inputs connected to the second flip-  
22 flop and the first logic circuit for producing a pulse when  
23 an inversion of the output from the second flip-flop is of  
24 the same binary state as the output from the first logic  
25 circuit.

26  
27 15. The video player synchronizer of claim 14 wherein the ref-  
28 erence moment determination circuit comprises a fourth logic circuit having  
29 inputs connected respectively to the first and the second flip-flop of the  
30 play synchronization circuit, and an output connected to the reset input  
31 of the first and the second flip-flop of the play synchronization circuit,  
32 for resetting the first and the second flip-flops upon simultaneous produc-  
33 tion of pulses by the first and the second flip-flops.

34  
35 16. The video player synchronizer of claim 14 wherein the first  
36 and the second video player have drive means for creating relative scan-

1     ning motion between the video storage medium and a transducer under  
2     the control of a first and a second servo signal, respectively, and where-  
3     in the play synchronization circuit of the synchronizer further comprises:

4         (a) a first adder having one input connected to the second logic cir-  
5             cuit, another input to be connected to the first video  
6             player for inputting the first servo signal, and an output  
7             to be connected to the drive means of the first video  
8             player; and

9         (b) a second adder having one input connected to the third logic  
10            circuit, another input to be connected to the second video  
11            player for inputting the second servo signal, and an output  
12            to be connected to the drive means of the second video  
13            player.

14  
15         17.     A synchronizer for compulsorily synchronizing a first, a  
16     second and a third video player for simultaneous display of correlated  
17     pictures, each video player being for use with a video storage medium  
18     on which there is stored a video signal including a series of vertical  
19     sync pulses, the synchronizer comprising:

20         (a) a first vertical sync pulse separator circuit to be connected to a  
21             first video player for separating a first series of vertical  
22             sync pulses from a first video signal being recovered from  
23             a first video storage medium;

24         (b) a second vertical sync pulse separator circuit to be connected to  
25             a the second video player for separating a second series of  
26             vertical sync pulses from a second video signal being re-  
27             covered from a second video storage medium;

28         (c) a third vertical sync pulse separator circuit to be connected to a  
29             third video player for separating a third series of vertical  
30             sync pulses from a third video signal being recovered from  
31             a third video storage medium;

32         (d) a reference moment determination circuit connected to the first  
33             and the second and the third vertical sync pulse separator  
34             circuit for determination of a reference moment in pre-  
35             scribed time relationship to each vertical sync pulse of a  
36             selected one of the first and the second and the third ser-

ies of such pulses being supplied from the first and the second and the third vertical sync pulse separator circuit; and

(e) a play synchronization circuit comprising a first and a second and a third *D* flip-flop having clock inputs connected respectively to the first and the second and the third vertical sync pulse separator circuit, reset inputs connected to the reference moment determination circuit, and data inputs connected to a supply terminal, for production of a first phase departure signal indicative of a phase departure, if any, of each vertical sync pulse of the first series from the reference moment determined in relation to one associated vertical sync pulse of the selected series, a second phase departure signal indicative of a phase departure, if any, of each vertical sync pulse of the second series from the reference moment determined in relation to one associated vertical sync pulse of the selected series, and a third phase departure signal indicative of a phase departure, if any, of each vertical sync pulse of the third series from the reference moment determined in relation to one associated vertical sync pulse of the selected series, the first and the second and the third phase departure signal being for delivery to the first and the second and the third video player, respectively, for causing the same to synchronize the first and the second and the third series of vertical sync pulses.

18. The video player synchronizer of claim 17 wherein the play synchronization circuit further comprises:

- (a) a first logic circuit having inputs connected to the first and the second and the third flip-flop for passing all output pulses thereof;
- (b) a second logic circuit having inputs connected to the first flip-flop and the first logic circuit for producing a pulse when an inversion of the output from the first flip-flop is of the same state as the output from the first logic circuit;

- 1 (c) a third logic circuit having inputs connected to the second flip-  
2 flop and the first logic circuit for producing a pulse when  
3 an inversion of the output from the second flip-flop is of  
4 the same binary state as the output from the first logic  
5 circuit; and  
6 (d) a fourth logic circuit having inputs connected to the third flip-  
7 flop and the first logic circuit for producing a pulse when  
8 an inversion of the output from the second flip-flop is of  
9 the same binary state as the output from the first logic  
10 circuit.

11  
12 19. The video player synchronizer of claim 18 wherein the ref-  
13 erence moment determination circuit comprises a fifth logic circuit having  
14 inputs connected respectively to the first and the second and the third  
15 flip-flop of the play synchronization circuit, and an output connected to  
16 the reset input of the first and the second and the third flip-flop of  
17 the play synchronization circuit, for resetting the first and the second  
18 and the third flip-flop upon simultaneous production of pulses by the  
19 first and the second and the third flip-flop.  
20

21 20. The video player synchronizer of claim 18 wherein the first  
22 and the second and the third video player have drive means for creating  
23 relative scanning motion between the video storage medium and a trans-  
24 ducer under the control of a first and a second and a third servo sig-  
25 nal, respectively, and wherein the play synchronization circuit of the syn-  
26 chronizer further comprises:  
27

- 28 (a) a first adder having one input connected to the second logic cir-  
29 cuit, another input to be connected to the first video  
30 player for inputting the first servo signal, and an output  
31 to be connected to the drive means of the first video  
32 player;  
33 (b) a second adder having one input connected to the third logic  
34 circuit, another input to be connected to the second video  
35 player for inputting the second servo signal, and an output  
36 to be connected to the drive means of the second video  
player; and



1 (c) a third adder having one input connected to the fourth logic cir-  
2 cuit, another input to be connected to the third video  
3 player for inputting the third servo signal, and an output  
4 to be connected to the drive means of the third video  
5 player.

6  
7 21. The video player synchronizer of claim 17 wherein the first  
8 and the second and the third video player have drive means for creating  
9 relative scanning motion between the video storage medium and a trans-  
10 ducer under the control of a first and a second and a third servo sig-  
11 nal, respectively, and wherein the play synchronization circuit of the syn-  
12 chronizer further comprises:

13 (a) a first subtracter having one input connected to the output of  
14 the first flop-flop, another input to be connected to the  
15 first video player for inputting the first servo signal, and  
16 an output to be connected to the drive means of the first  
17 video player;

18 (b) a second subtracter having one input connected to the output of  
19 the second flip-flop, another input to be connected to the  
20 second video player for inputting the second servo signal,  
21 and an output to be connected to the drive means of the  
22 second video player; and

23 (c) a third subtracter having one input connected to the output of  
24 the third flop-flop, another input to be connected to the  
25 third video player for inputting the third servo signal, and  
26 an output to be connected to the drive means of the third  
27 video player.

28  
29 22. A video player system for synchronous display of a plurali-  
30 ty of correlated pictures, comprising:

31 (a) a display;

32 (b) a plurality of video players for recovering from video storage  
33 media a set of correlated video signals for joint visual pre-  
34 sentation on the display, each video signal including a ser-  
35 ies of vertical sync pulses;

36 (c) a plurality of vertical sync pulse separator circuits connected one

1 to each video player for separating the series of vertical  
2 sync pulses from the video signals being recovered from  
3 the video storage media;

4 (d) a reference moment determination circuit connected to the vertical  
5 sync pulse separator circuits for determination of a refer-  
6 ence moment in prescribed time relationship to each vertical  
7 sync pulse of one selected series of such pulses being  
8 supplied from one of the vertical sync pulse separator cir-  
9 cuits;

10 (e) a play synchronization circuit connected to the vertical sync pulse  
11 separator circuits and the reference moment determination  
12 circuit for production of a plurality of phase departure  
13 signals each indicative of a phase departure, if any, of  
14 each vertical sync pulse of one series of such pulses from  
15 the reference moment determined in relation to one associat-  
16 ed vertical sync pulse of the selected series of such  
17 pulses; and

18 (f) drive means in each video player for creating relative scanning  
19 motion between a transducer and the video storage medium,  
20 the drive means being connected to the play synchroniza-  
21 tion circuit for reducing the phase departure of the verti-  
22 cal sync pulse from the reference moment in response to  
23 one phase departure signal from the play synchronization  
24 circuit.

25  
26 23. The video player system of claim 22 further comprising:

27 (a) a controller in each video player for providing a servo signal for  
28 servo control of the drive means; and

29 (b) an adder having an input connected to the play synchronization  
30 circuit and another input connected to the controller of  
31 each video player for supplying an addition of one phase  
32 departure signal and one servo signal to the drive means  
33 of each video player.

34  
35 24. The video player system of claim 22 further comprising:

36 (a) a controller in each video player for providing a servo signal for

1            servo control of the drive means; and

- 2        (b) a subtracter having an input connected to the play synchroniza-  
3            tion circuit and another input connected to the controller  
4            of each video player for supplying a difference of one  
5            phase departure signal and one servo signal to the drive  
6            means of each video player.

7  
8        25.    The video player system of claim 22 further comprising:

- 9        (a) a controller in each video player for providing a play command  
10            for the video player; and  
11        (b) a status judgment circuit connected between the controllers of all  
12            the video players and the play synchronization circuit for  
13            permitting the latter to synchronize the video players only  
14            when all the video players are in play mode.

15  
16        26.    The video player system of claim 22 further comprising:

- 17        (a) a controller in each video player for providing a play command  
18            for the video player; and  
19        (b) means connected between the controllers of the video players  
20            and the play synchronization circuit for permitting the lat-  
21            ter to deliver the phase departure signals only to the  
22            drive means of those video players which are in play mode.